Advant® OCS
with Master software

HART™ Protocol Interface

User's Guide

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CAUTION	Hazards which could result in equipment or property damage
NOTE	Alerts user to pertinent facts and conditions

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Chapter 1 Introduction

1.1 General Information

This manual describes how to connect and use analog transmitters which use the HART protocol for communication on top of the 4-20 mA current loop to the Advant Controller 410 (AC 410) and Advant Controller 450 (AC 450) systems.

The interface is based on the use of external products, which are connected to the Advant Controller 410/450 system, thus making an integrated solution.

The Applied System TEChnologies (ASTEC) Cornerstone base station product gives a comprehensive functionality, including calibration reports, event list and value history for set up and maintenance of HART-based transmitters.

The Arcom H-View SW has more limited history and access logging functions but are easier to install and use.

Normally it is not possible in the current products to transfer secondary or tertiary process values into the Advant Controller 410/450’s process data base, but an application note exists, describing a rather cumbersome method of doing it, via DDE links and AdvaSoft for Windows.

The Arcom HPORT HART multiplexer shall be used in cooperation with either of the above mentioned SW products, as the hardware interface. A special connection cable exists, which makes the installation together with the ABB Master S100 I/O system easy.

If you are using Intrinsic Safety barriers in combination with HART transmitters, then you can connect the Elcon series 1700 multiplexer module interface instead of the Arcom HPORT to get an integrated IS and HART interface.

This book is not intended to be the sole source of instruction for the HART interface and use. The user manuals for the Arcom HPORT, the Arcom HView or the ASTEC Cornerstone base station should also be read. People involved in system engineering should attend the applicable system engineering courses offered by the local ABB representative.

1.2 Equipment Requirements

ASTEC Cornerstone base station requires a Personal computer, PC, running Microsoft Windows. It must be at least a 386SX, running Windows ver 3.1x and DOS 5.0 or higher with minimum 8 MBytes of RAM and 8 MBytes of Hard disk space available for the cornerstone installation. Additionally you need 105kB per HART instrument for the instrument data base.

The PC must have one free RS-232-C (or RS-485) serial communication port, and at least a VGA-compatible monitor.

Arcom H-View requires a PC-compatible, at least a 386SX, running Windows ver 3.1x with minimum 4 MBytes of RAM and 1 MBytes of Hard disk space available.

The PC must have one free RS-232-C (or a RS-485) serial communication port.

In general, we recommend to use at least a 66 MHz 486DX4 or a Pentium, and at least 16 MBytes of RAM and a suitably big hard disk, with one free serial and one free parallel port, one free ISA bus slot and at least a VGA-compatible monitor.

The following units must be purchased direct from the source:

- Applied System Technologies Inc. (ASTEC) “Cornerstone base station” operator SW

  or

  Arcom H-View HART operator SW
- Arcom “HPORT” HART Multiplexer(s)
- One RS-232-C to RS-485 converter (for short distances)

  or

  One RS-485 to opto converter and one opto to RS-485 and a RS-485 to RS-232-C (the latter two may be combined into one unit) converter (long distances)
- Elcon Intrinsic Safety isolators and series 1700 HART multiplexer(s) (if used)

The following parts are normally purchased from ABB:

- ABB connection cable(s) to connect the Arcom HPORT to the appropriate ABB Master S100 I/O analog interface board and connection unit.
- ABB connection cable(s) to connect the Elcon MUX 1700 Multiplexer to the appropriate ABB Master S100 I/O analog interface board and connection unit, when used for Intrinsic Safety applications.
- ABB RA120 (19”) or RA121 (24”) mounting bar for each HPORT multiplexer.
- Appropriate ABB Master S100 I/O analog 4-20 mA input- or output board(s)
- Appropriate ABB Master S100 I/O connection unit(s) for the I/O board

1.3 Manual Organization

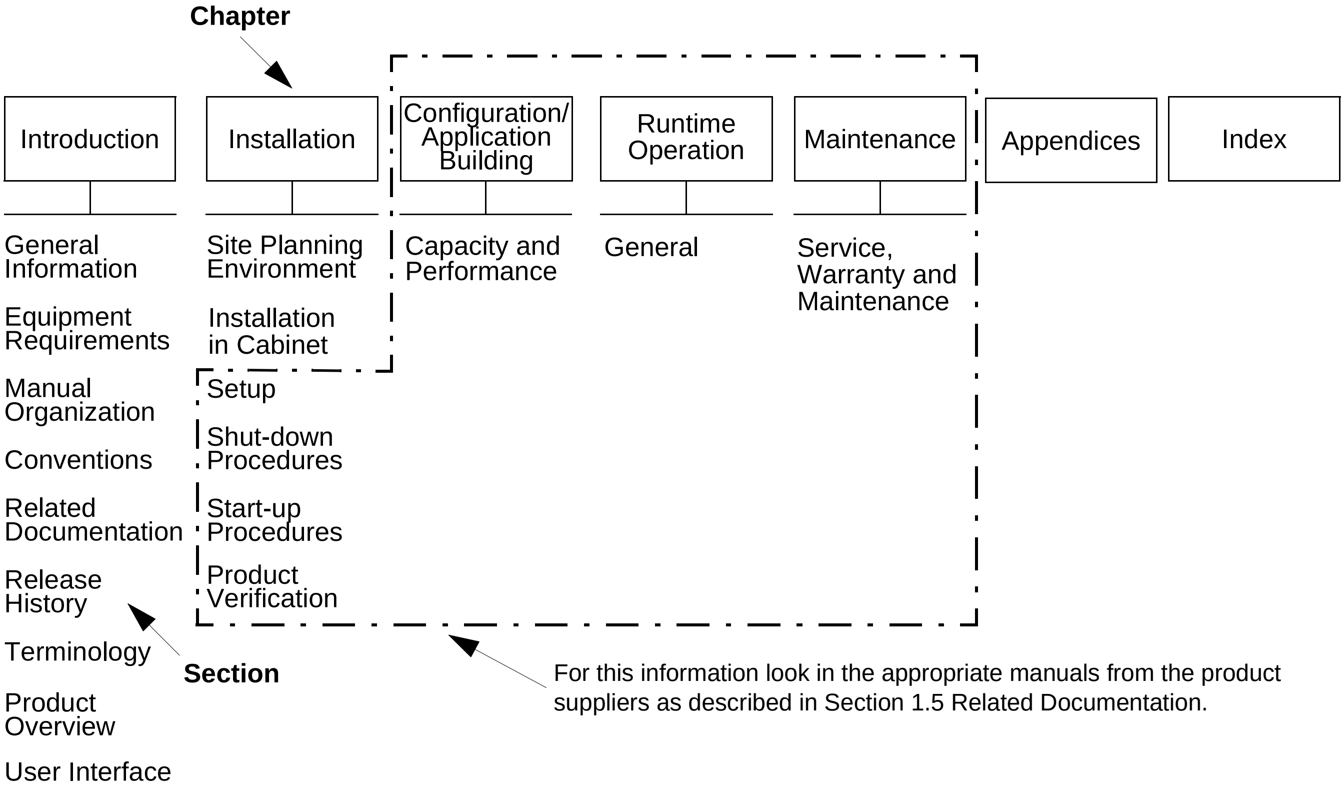


Figure 1-1. Basic Documentation Structure

1.4 Conventions

Not relevant in this document.

1.5 Related Documentation

The following non-ABB manuals are needed:

- Arcom Control Systems Ltd.
  HPORT 32 channel HART Multiplexer User’s Manual (J386HPORT)
- Applied Systems Technologies Inc.
  Cornerstone base station Installation Manual
- Applied Systems Technologies Inc.
  Cornerstone base station Users Manual for HART Interface ComLib
- Applied Systems Technologies Inc.
  User’s Manual for Cornerstone base station
- Arcom H-View HART Network I/F for Windows (User’s manual)

To use the system a full set of ABB Master User's Guides are needed, but for the installation and initiation phase especially the following manuals are needed:

- *S100 I/O Hardware Reference Manual*
- *ABB Master Terminal Diagram Forms*

For use with Elcon Intrinsic Safety isolators and HART transmitters the following manuals are also needed:

- *Elcon MUX 1700 Multiplexer Instruction Manual Type 1700 Multiplexer Rev 3* (For use with intrinsic safety isolators)
- *ABB Advant OCS with Master software, Intrinsic Safety Support, S100 I/O User's Guide*

1.6 Release History

The description in this user's guide is based on

ASTEC Cornerstone base station version 2.0.10

Arcom HPORT version 1 Iss3

Arcom H-View HART Network I/F for Windows Issue A

Elcon Series 1700 Multiplexer Rev. 3

1.7 Terminology

Not relevant in this document.

1.8 Product Overview

1.8.1 Normal (non-IS) HART Installation

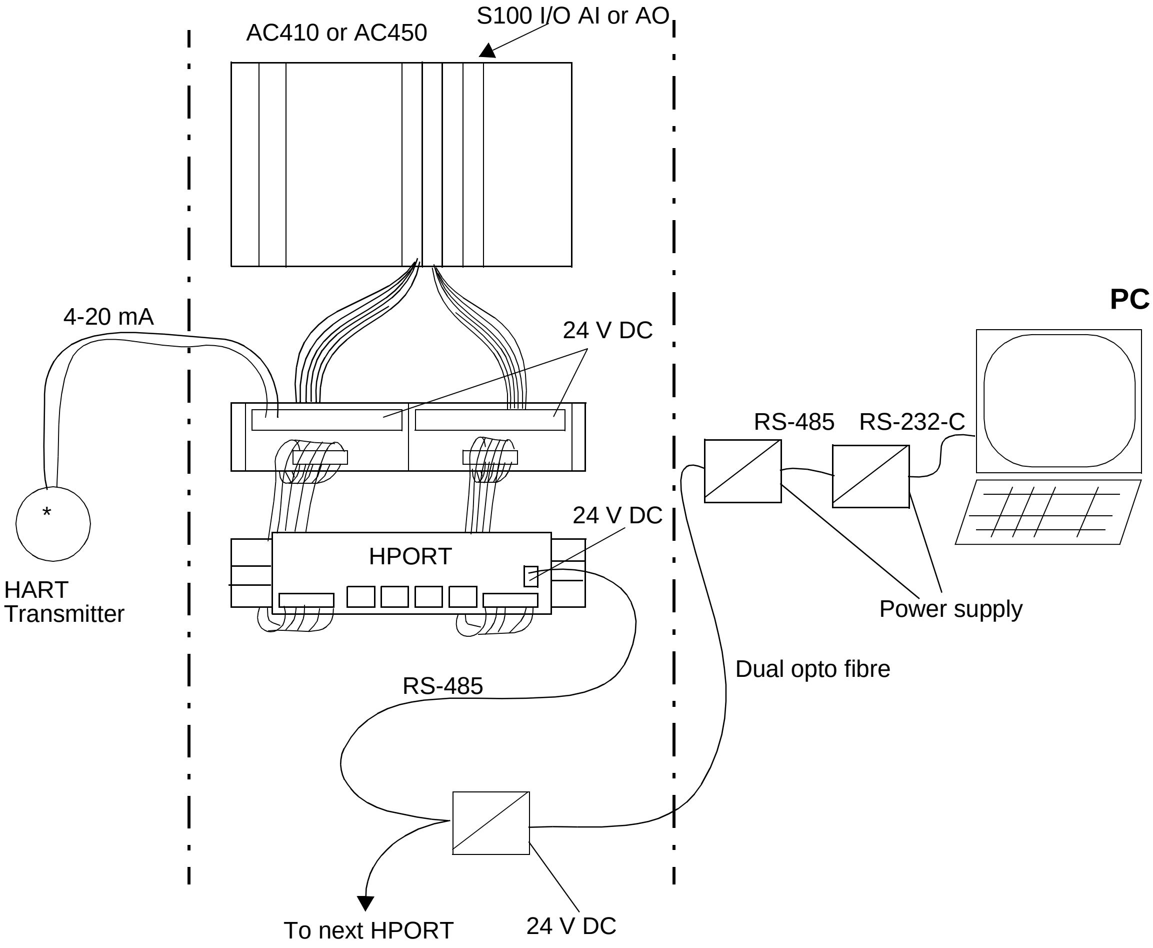


Figure 1-2. Installation Overview, HART Interface and Arcom HPORT Multiplexer

Table 1-1. S100 I/O Boards, Connection Units and Cables for the Arcom HPORT HART Interface, to get 32 Channels

Number of S100 I/O Boards to get 32 Channels	S100 I/O Board	No of Channels	Connection Unit	Typical Data	Cable	ABB Order-sets needed for 32 Channels
1	DSAI 133	32	2*DSTA 002	12 bit AI	DSTK 205	1
2	DSAX 110	2*(8 + 8)	2*DSTA 001	12 bit AI, 12 bit AO	2*DSTK 204	2
4	4*DSAO 120	4*8	4*DSTA 170	12 bit AO	2*DSTK 206[1]	2
2	2*DSAO 130	2*16	2*DSTA 180	8 bit AO	2*DSTK 203	2

[1] Also available in set with only one 8ch DSAO 120, one DSTA 170 connection unit and one cable. DSTK 206.

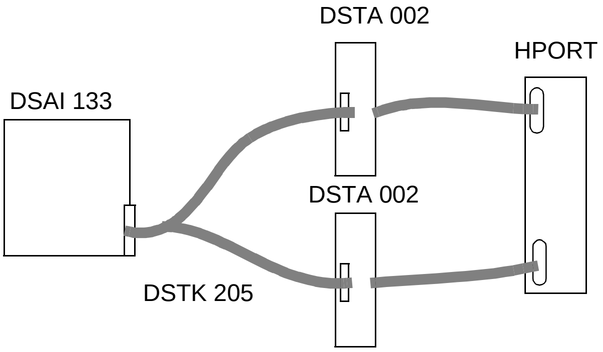


Figure 1-3. Connection with DSAI 133, 32 Channels, one Order-set

NOTE

The HPORT itself is not included in the order-set.

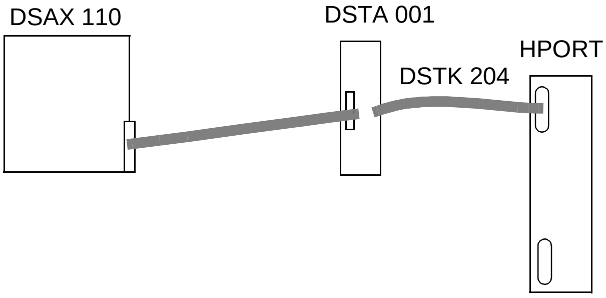


Figure 1-4. Connection with DSAX 110, 16 Channels, one Order-set

NOTE

The HPORT itself is not included in the order-set.

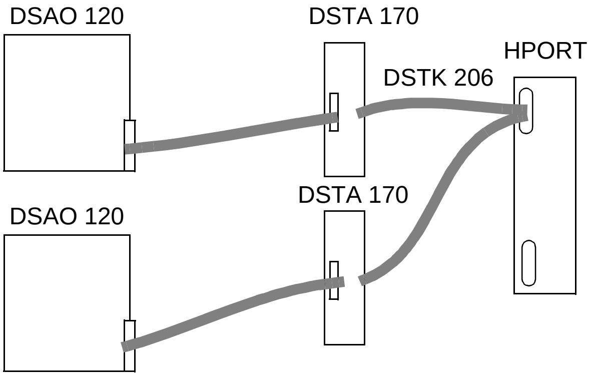


Figure 1-5. Connection with DSAO 120, 16 Channels, one Order-set

NOTE

The HPORT itself is not included in the order-set.

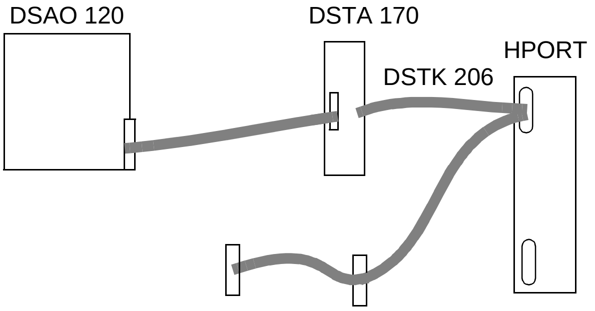


Figure 1-6. Connection with DSAO 120, 8 Channels, one Order-set

NOTE

The HPORT itself is not included in the order-set.

1.8.2 Intrinsic Safety HART Installation

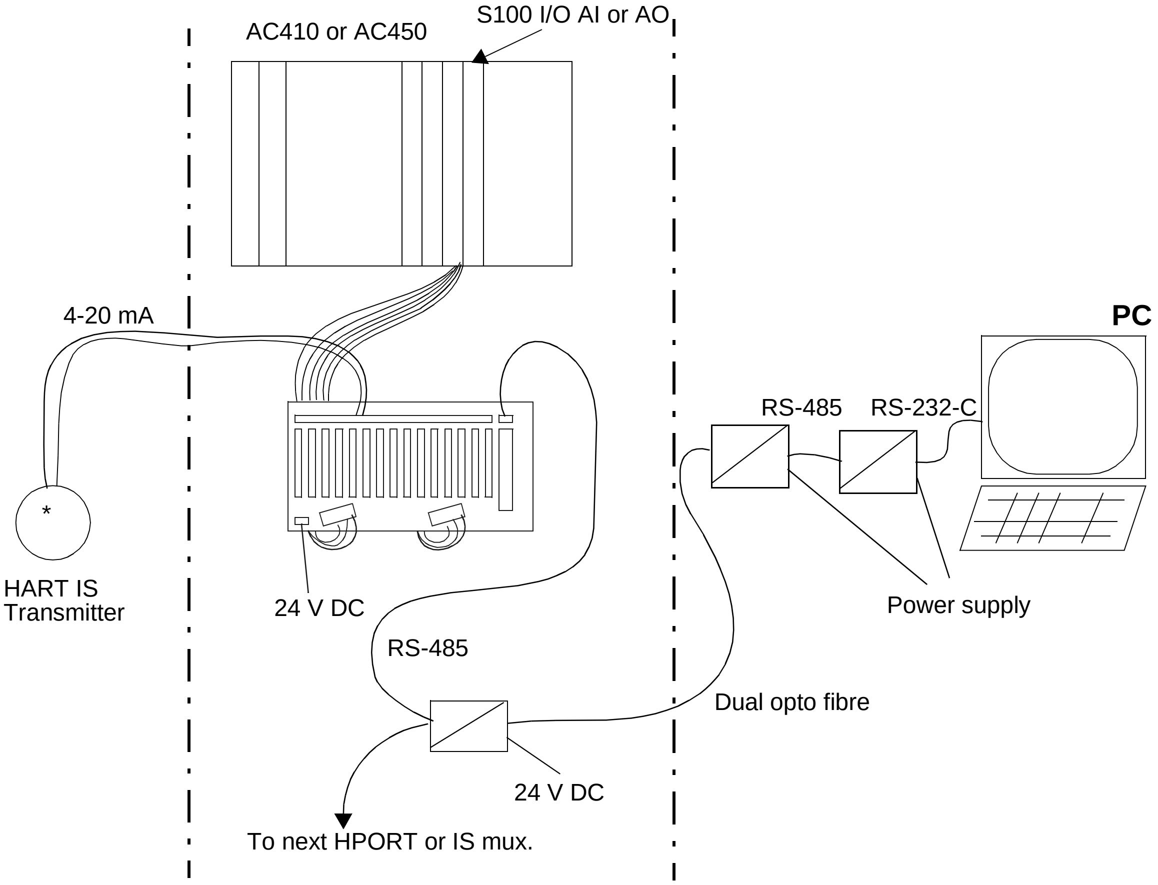


Figure 1-7. Installation Overview, HART Interface and Elcon Series 1700 Multiplexer and Intrinsic Safety Barriers

The physical installation shall conform to the instructions given in the relevant Elcon documents.

Elcon Termination boards Series 1700 number 1216/TB-CON5-H-DS for 16 modules shall be used.

Table 1-2. S100 I/O Boards, Connection Units and Interface Adapter Cards for the Elcon Intrinsic Safety HART Interface

S100 I/O Board	Cable [(1)]	Typical Data	No of IS Module Places	Elcon Interface Adapter Card	Elcon Termination Board
DSAI 133	DSTK 152SL10	12 bit AI	16	IA-AB-AIO-01-I	1216/TB-CON5-H-DS
2*DSAX 110	2*DSTK 153SL10	12 bit AI, 12 bit AO	16	IA-AB-AIO-01-I	1216/TB-CON5-H-DS
4*DSAO 120	4*DSTK 153SL10	12 bit AO	16	IA-AB-AO-02-I[(2)]	1216/TB-CON5-H-DS

(1) Shielded cable should be used, SL10 gives 10 m of cable, SL15 gives 15 m.
(2) Two interface adapter cards is needed.

1.8.3 Redundant Analog Channels and (non-IS) HART Installation

DSAI 133 and DSAX 110 can be used also in configurations for redundant I/O. Only the I/O that handles the analog values (i.e. the primary process value) are redundant. It is possible to connect a single non-redundant HART HPORT multiplexer to the redundant I/O system, as shown below in Figure 1-8 and Figure 1-9.

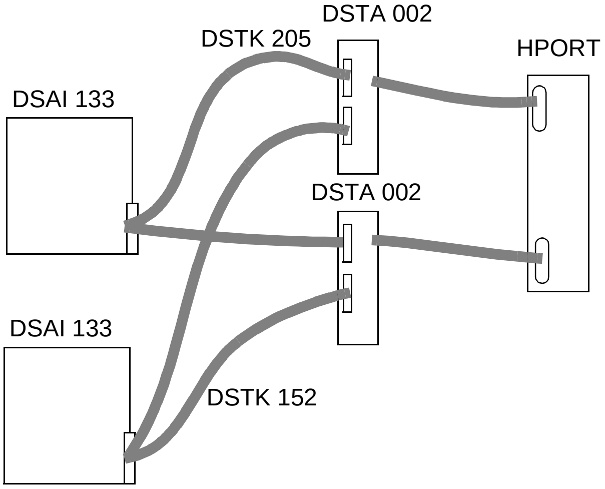


Figure 1-8. Connection with Redundant DSAI 133, 32 Channels, one Order-set.

NOTE
The HPORT itself is not included in the order-set.

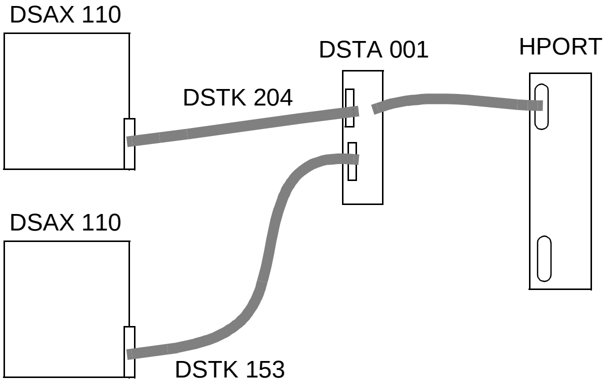


Figure 1-9. Connection with Redundant DSAX 110, 16 Channels, one Order-set

NOTE

The HPORT itself is not included in the order-set.

1.8.4 Purchase Information

Products from Elcon, Arcom and Applied systems technologies shall be ordered directly from the manufacturer, referencing the contract between ABB and the manufacturer, giving a discount.

Table 1-3. Purchase Information

Product	Product Identification	Producer	Address
Arcom HPORT 32 channel HART Multiplexer		Arcom Control Systems Ltd.	Units 8-10, Clifton Road, Cambridge, BB1 4WH, United Kingdom phone +44 (0)223 411 200 fax +44 (0)223 410 457
Arcom H-View			
ASTEC Cornerstone base station		Applied System Technologies Inc.	3350 N.W. 53rd Street, Suite 101 Fort Lauderdale, Florida 33309, USA Phone +1 305 735 2507 fax: +1 305 735 0963
Elcon Type 1700 Multiplexer (1)		Elcon Instruments Srl	Via Velasca 36A, 20059 Vimercate, Milano, Italy phone +39 39 6082 585 fax +39 39 6082 586

Table 1-3. Purchase Information (Continued)

Product	Product Identification	Producer	Address
RS-485 to RS-232-C converter (2)	Keithly Model M1100 RS232/RS-485 Converter/Repeater (M1100-115: 115 V AC M1100-230; 230 V AC M2000: 10-30 VDC)	Keithly / Metrabyte	440 Myles Standish Blvd. Taunton, MA 02780, USA phone +1 508 880 3000 fax +1 508 880 0179 Repr. in Sweden: Kaliber AB phone +46 (0)8 380 350 fax +46 (0)8 380320
	Telebyte Model 285 Superverter	Telebyte Technology Inc.	270 Pulaski Rd. Greenlawn, New York NY 11740, USA phone +1 516 423 3232 fax +1 516 385 8184 Repr. in UK: Open Networks Eng. Ltd. phone +44 (0)1279 870101 fax +44 (0)1279 870860
	Black Box Model LD485A-MP (Heath com article number ME836A-E)	Black Box Corp.	Black Box Corporation 1000 Park Drive, Lawrence, Pennsylvania 15055 USA phone +1 412 746 5500 fax +1 412 746 0746 Repr. in Sweden: Heath Com. phone +46 (0)8 733 73 00 fax +46 (0)8 733 23 30
RS-485 to opto converter with ST connectors, 24V DC power supply(3)	OZD 485 G2 BFOC 943 290-021	Hirschmann Netwerktechnik	Postfach 1649 72 606 Nürtingen, Germany Repr. in Sweden: Tesch system AB Box 21196 S-10031 Stockholm phone +46 (0)8 321210 fax +46 (0)8 330058
230 V AC to 5 VDC supply(4)	SNT 503 268 109-001		
Twisted pair cable to RS-485	FLFR 2*2*0.5 1687 0032-1 (5)		
Dual optofibre with ST connectors	62,5/125 um (6)		

(1) For information about the Intrinsic safety isolators and installation of those, see the ABB manual *Intrinsic Safety Support S100 I/O User's Guide.*
(2) More models might be useful, the telebyte converter has been used by ABB.
(3) More models might be useful.
(4) More models might be useful.
(5) Most shielded twisted-pair cables designed for data communication could be used.
(6) Multimode glass fibre. Actual cable-type dependant on installation environment.

1.9 User Interface

For this information look in the appropriate manuals from the product suppliers as described in Section 1.5 Related Documentation.

Chapter 2 Installation

2.1 Site Planning Environment

When site planning, it is important that you check that requirements for environmental conditions (temperature, humidity, chemical), grounding and power supply are met, according to standards for your application. This is stated in the hardware documentation for your PC and communication interfaces.

NOTE

RS-485 communication between the HART multiplexer and the personal computer (PC) has limited capability to withstand common mode voltages.

It is thus important that the PC and the external modem is connected to the same ground.

Connect the mounting plate as shown in the figure below.

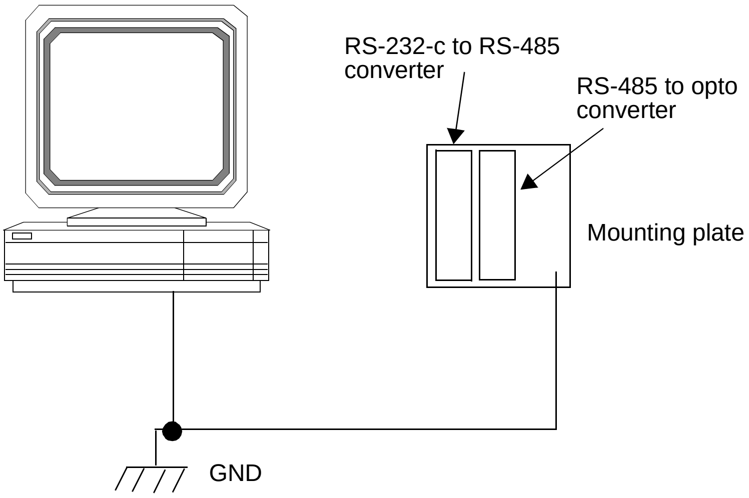


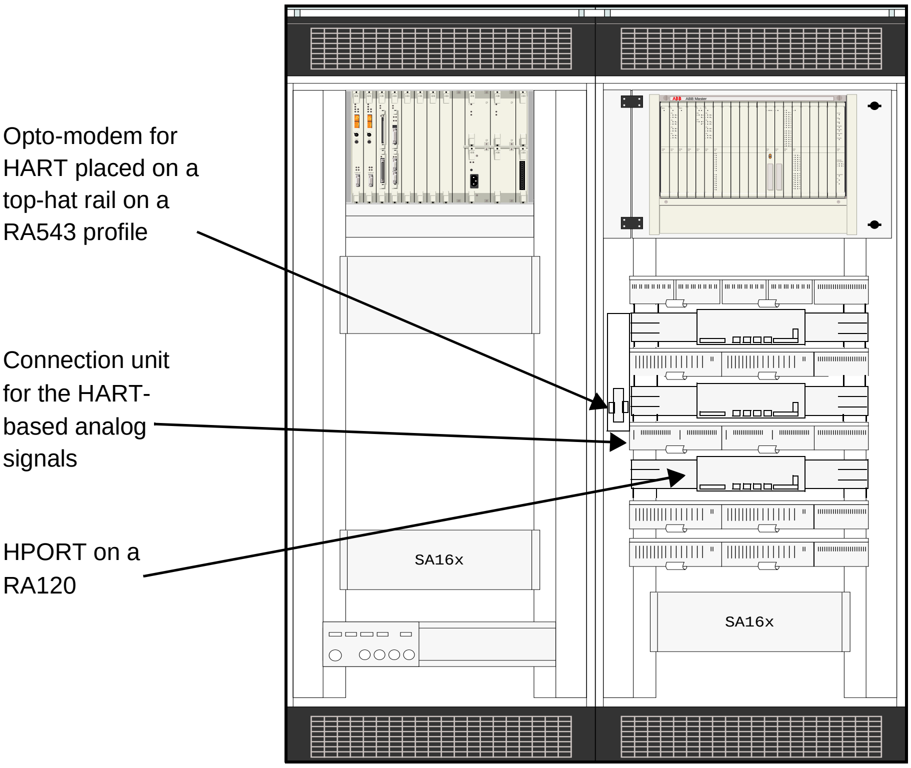
Figure 2-1. PC and Modem Grounding Requirements

For communication to the HPORT for short distances (<30m) and within the same grounding-system, a screened twisted pair communication cable must be used, and no other signals may exist on any other pair in the same cable, if any. The screen should be grounded in both ends, and at each node connected in multi-drop. The common mode voltage over the cable must not exceed ± 5 V, and thus must be used only within the same stable ground system. For longer distances an opto-fibre-based system must be used.

A maximum of 31 HPORT multiplexers may be placed on one RS-485 cable.

For longer distances (>30m) between the HPORT and the PC running the H-View or Cornerstone base station, or in an installation with excessive EMI, use an optical fibre with RS-485 to opto or RS-232C to opto converters to extend the RS-485 or RS-232C cable.

2.2 Installation in Cabinet



Opto-modem for HART placed on a top-hat rail on a RA543 profile

Connection unit for the HART-based analog signals

HPORT on a RA120

Figure 2-2. Advant Controller 450, Example of Physical Appearance

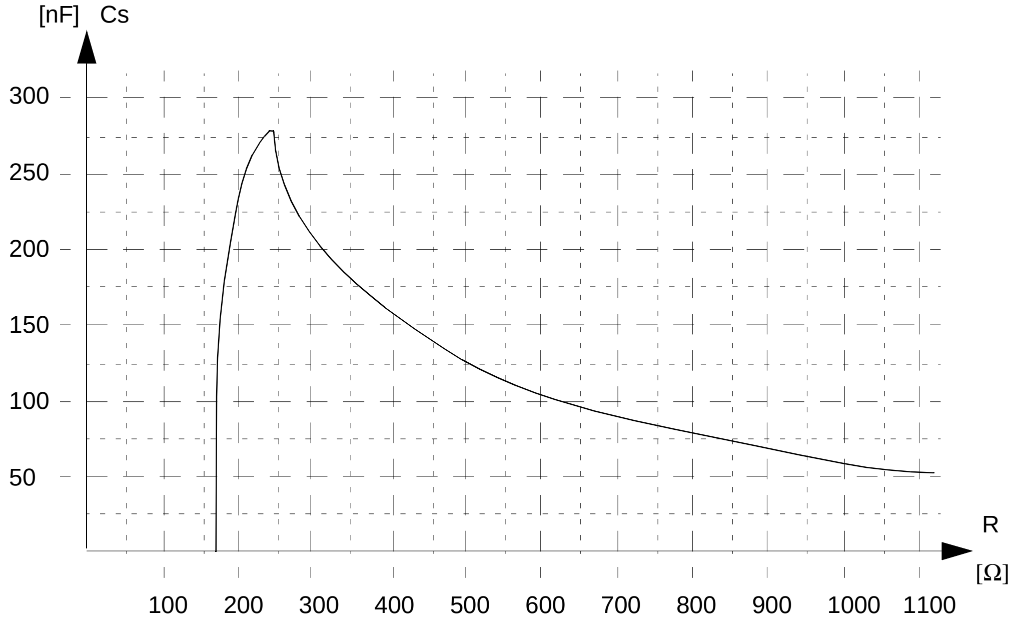
The optomodem for the HART communication shall be placed on a 60 mm long “t lop-hat-rail” ABB 1376 1910-1, on a RA543 profile, placed in the left side of the RE5xx cabinet.

The HPORT multiplexer is to be placed on a RA120/121 mounting bar, which has an integrated “top-hat rail” on it. The RA120/121 with the HPORT should be placed underneath the mounting-bar for the connection-unit with it’s associated analog signal connection for the channels involved.

The connector for the HPORT on the cable coming from the S100 I/O-board and its associated connection unit, will be marked with the item designation number corresponding to the location of the S100 I/O-board in the rack.

2.2.1 Load Calculations

Maximum cable lengths can be calculated as shown below when using the HPORT together with the S100 I/O. For IS applications with the Elcon series 1700 system, see the appropriate Elcon documentation.



Cs = Maximum allowed system capacitance, [nF]
R = Equivalent network resistance, ([Ω] , ohms)

Figure 2-3. Equivalent Network Resistance (ohms)

The calculation should be performed in the following steps:

1. Calculate the *Equivalent Network Resistance,* R_{DEV} i.e. the resistance of all connected devices, in parallel. $R_{DEV} = R_{DEV1} \| R_{DEV2} \|...$ where R_{DEVx} is the Terminal-to-Terminal resistance of a network device.
2. Read the associated *Maximum Allowable System Capacitance*, Cs, from the curve in Figure 2-3 above.
3. Calculate the *Cable Capacitance,* Cc, where $Cc=Cs-C_{DEV1} - C_{DEV2}$ -..., where C_{DEVx} is the greater of the two; Terminal-Terminal capacitance or Terminal - Case, of a network device.
4. Calculate the *Maximum Cable Length*, MCL, where $MCL = \frac{Cc}{Kc}$ and Kc is the cable capacitance per unit length.

For the S100 devices the following data apply:

Table 2-1. S100 I/O Terminal Data

Device	R_{DEV}	C_{DEV}
DSAI 133	250 ohms	<1 nF
DSAX 110, inputs	250 ohms	<1 nF
DSAX 110, outputs	>300 kohms	10 nF
DSAO 120	300 kohms	20 nF

For the data concerning the HPORT multiplexer, see the appropriate Arcom manuals. The current model has according to Arcom a R_{DEV} = 140 kohms when operating as a receiver and R_{DEV} = 75 to 78 ohms when operating as a transmitter, The imaginary part, C_{DEV}, is mostly inductive, and need not to be used in the calculations.

Example

HPORT R_{DEV}= 140 kohms, we assume additionally a C_{DEV} of 1 nF.

DSAI 133 input R_{DEV}= 250 ohms, C_{DEV}= 1 nF's

Transmitter output R_{DEV}= 200 kohms, C_{DEV} = 15 nF (just as an example)

Cable capacitance 250 pF/m

which gives

$1/R_{DEV} = 1/140000 + 1/250 + 1/200000$ and thus R_{DEV} = 249 ohms. Figure 2-3 gives then maximum allowable system capacitance of 260 nF.

Cc is then 260-1-1-15 = 243 nF. Which gives MCL = 243/0.250 = 970 m.

2.3 Setup

For this information look in the appropriate manuals from the product suppliers as described in Section 1.5 Related Documentation.

In the PC the following programs must be installed:

- MS Windows 3.1x
- Arcom H-View or ASTEC Cornerstone base station.

2.4 Shut-down Procedures

For this information look in the appropriate manuals from the product suppliers as described in Section 1.5 Related Documentation.

2.5 Start-up Procedures

For this information look in the appropriate manuals from the product suppliers as described in Section 1.5 Related Documentation.

2.6 Product Verification

For this information look in the appropriate manuals from the product suppliers as described in Section 1.5 Related Documentation

Chapter 3 Configuration/Application Building

3.1 Capacity and Performance

Not relevant in this document.

Chapter 4 Runtime Operation

4.1 General

For this information look in the appropriate manuals from the product suppliers as described in Section 1.5 Related Documentation.

Chapter 5 Maintenance

5.1 Service, Warranty and Maintenance

Service, warranty and maintenance for the non-ABB products should be performed by the producer or his representative, and normally not by ABB.

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March, 1997